

In the Claims:

1. (Currently amended) A computer-implemented method of modeling a three-dimensional surface of an object, comprising the steps of:

generating from an initial triangulation of the surface, a hierarchy of progressively coarser triangulations of the surface by performing a sequence of edge contractions to the initial triangulation;

connecting the triangulations in the hierarchy using homeomorphisms; and

homeomorphically mapping edges of a triangulation in the hierarchy back to the initial triangulation.

2. (Currently amended) The computer-implemented method of Claim 1, wherein said mapping step comprises homeomorphically mapping edges of a coarsest triangulation in the hierarchy back to the initial triangulation.

3. (Currently amended) The computer-implemented method of Claim 2, wherein said mapping step is followed by the step of:

converting the mapped coarsest triangulation to a quadrangulation by matching pairs of adjacent triangles in the mapped coarsest triangulation.

4. (Currently amended) The computer-implemented method of Claim 3, wherein the pairs of adjacent triangles are matched using a weighting function for edges of the triangles.

5. (Currently amended) The computer-implemented method of Claim 3, wherein said converting step comprises:

decomposing an isolated triangle that cannot be matched in the mapped coarsest triangulation into three quadrangles; and

decomposing a quadrangle derived from a matched pair of adjacent triangles into a mesh of four quadrangles.

6. (Currently amended) The computer-implemented method of Claim 3, further comprising the step of fitting a respective grid to each of a plurality of quadrangles in the quadrangulation by decomposing each of the quadrangles into k^2 smaller quadrangles, where k is a positive integer greater than one.

7. (Currently amended) A computer-implemented method of modeling a three-dimensional surface of an object, comprising the steps of:

generating from an initial triangulation of the surface, a hierarchy of progressively coarser triangulations of the surface by decimating the initial triangulation using a sequence of edge contractions that are prioritized by an error function that measures a respective error caused by the edge contractions in the sequence;

connecting the triangulations in the hierarchy using homeomorphisms; and homeomorphically mapping edges of a coarsest triangulation in the hierarchy back to the initial triangulation.

8. (Currently amended) The computer-implemented method of Claim 7, wherein said generating step comprises generating a first triangulation from the initial triangulation by contracting a first edge in the initial triangulation and measuring a first error associated with the first edge contraction; and wherein said connecting step comprises generating a first simplicial homeomorphism for the first triangulation.

9. (Currently amended) The computer-implemented method of Claim 8, wherein said connecting step comprises generating the first simplicial homeomorphism for the first triangulation by determining a fuzzy rank of a submatrix of a fundamental quadric used by the error function to measure the first error.

10. (Currently amended) A computer-implemented method of modeling a three-dimensional surface of an object, comprising the steps of:

generating from an initial triangulation of the surface, a hierarchy of progressively coarser triangulations of the surface by repeatedly decimating the initial triangulation using a sequence of edge contractions that are prioritized by an error function that measures a respective error caused by each of the edge contractions in the sequence, until a coarsest triangulation having a target density of triangles therein is achieved;

connecting the triangulations in the hierarchy using homeomorphisms; and
homeomorphically mapping edges of the coarsest triangulation in the hierarchy back to the initial triangulation.

11. (Currently amended) The computer-implemented method of Claim 10, wherein said connecting step comprises generating a respective simplicial homeomorphism for each of the triangulations in the hierarchy by determining a respective fuzzy rank that is attributable to a corresponding edge contraction in the sequence giving rise to the respective triangulation.

12. (Currently amended) The computer-implemented method of Claim 11, wherein said mapping step is followed by the step of:

converting the mapped coarsest triangulation to a quadrangulation by matching pairs of adjacent triangles in the mapped coarsest triangulation.

13. (Currently amended) The computer-implemented method of Claim 12, wherein the pairs of adjacent triangles are matched using a weighting function for edges of the triangles.

14. (Currently amended) The computer-implemented method of Claim 12, wherein said converting step comprises:

decomposing an isolated triangle that cannot be matched in the mapped coarsest triangulation into three quadrangles; and

decomposing a quadrangle derived from a matched pair of adjacent triangles into a mesh of four quadrangles.

15. (Currently amended) The computer-implemented method of Claim 12, further comprising the step of fitting a respective grid to a plurality of quadrangles in the quadrangulation by decomposing each of the plurality of quadrangles into k^2 smaller quadrangles, where k is a positive integer greater than one.

16. (Currently amended) A computer-implemented method of generating a three-dimensional model of an object, comprising the steps of:

decomposing an initial triangulation of the model into a quadrangulation of the model defined by a plurality of quadrangular patches that are joined together at patch boundaries by:

generating from the initial triangulation of the model a hierarchy of progressively coarser triangulations of the model using a sequence of edge contractions to the initial triangulation;

connecting the triangulations in the hierarchy using homeomorphisms; homeomorphically mapping edges of a coarsest triangulation in the hierarchy back to the initial triangulation; and

converting the mapped coarsest triangulation to the quadrangulation by matching pairs of adjacent triangles in the coarsest triangulation.

17. (Currently amended) The computer-implemented method of Claim 16, wherein said generating step comprises generating a first triangulation from the initial triangulation by contracting a first edge in the initial triangulation and measuring a first error associated with the first edge contraction; and wherein said connecting step comprises generating a first simplicial homeomorphism for the first triangulation.

18. (Currently amended) The computer-implemented method of Claim 17, wherein said mapping step comprises determining an inverse of a composition of the homeomorphisms.

19. (Currently amended) A computer-implemented method of modeling a three-dimensional surface of an object, comprising the steps of:
converting a first triangulation of the surface into a second triangulation of the surface by contracting a first edge in the first triangulation;
determining a fuzzy rank associated with the first edge contraction; and
determining a simplicial homeomorphism based on the fuzzy rank.

20. (Currently amended) A computer-implemented method of modeling a three-dimensional surface of an object, comprising the step **[[steps]]** of:
converting an initial triangulation of the surface into a quadrangulation of the surface that is homeomorphic to the triangulation by:
generating from the initial triangulation a hierarchy of progressively coarser triangulations of the surface by performing a sequence of edge contractions to the initial triangulation; and
mapping edges of a triangulation in the hierarchy back to the initial triangulation.

21. (Currently amended) The computer-implemented method of Claim 20, wherein said converting step further comprises converting the mapped triangulation to the quadrangulation by matching pairs of adjacent triangles in the mapped triangulation.

22. (Currently amended) The computer-implemented method of Claim 20, wherein said converting step comprises:

determining respective first homeomorphisms associated with each of the triangulations in the hierarchy;

determining a composition of the first homeomorphisms; and

determining an inverse of the composition of the first homeomorphism.

Claims 23-35 (Canceled).

36. (Currently amended) A computer program product that models a three-dimensional surface of an object and comprises a computer-readable storage medium having computer-readable program code embodied in said medium, said computer-readable program code comprising:

computer-readable program code that generates from an initial triangulation of the surface, a hierarchy of progressively coarser triangulations of the surface by performing a sequence of edge contractions to the initial triangulation;

computer-readable program code that connects the triangulations in the hierarchy using homeomorphisms; and

computer-readable program code that homeomorphically maps edges of a coarsest triangulation in the hierarchy back to the initial triangulation.

37. (Original) The product of Claim 36, further comprising computer-readable program code that converts the mapped coarsest triangulation to a quadrangulation by matching pairs of adjacent triangles in the mapped coarsest triangulation.

38. (Currently amended) A computer program product that models a three-dimensional surface of an object and comprises a computer-readable storage medium having computer-readable program code embodied in said medium, said computer-readable program code comprising:

computer-readable program code means that generates from an initial triangulation of the surface, a hierarchy of progressively coarser triangulations of the surface by decimating the initial triangulation using a sequence of edge contractions that are prioritized by a quadratic error function that measures a respective error caused by each of the edge contractions in the sequence;

computer-readable program code means that connects the triangulations in the hierarchy using homeomorphisms; and

computer-readable program code means that homeomorphically maps edges of a coarsest triangulation in the hierarchy back to the initial triangulation.

39. (Original) The product of Claim 38, wherein said means that generates comprises computer-readable program code means that generates a first triangulation from the initial triangulation by contracting a first edge in the initial triangulation and measuring a first error associated with the first edge contraction; and wherein said means that connects comprises computer-readable program code means that generates a first simplicial homeomorphism for the first triangulation.

40. (Original) The product of Claim 39, wherein said means that connects comprises computer-readable program code means that determines a fuzzy rank of a submatrix of a fundamental quadric used by the quadratic error function to measure the first error.

Claim 41 (Canceled).

42. (Currently amended) An apparatus that generates models of objects, comprising:

means for decomposing an initial triangulation of a model into a quadrangulation of the model defined by a plurality of quadrangular patches that are joined together at patch boundaries [[by:]], said decomposing means comprising:

means for generating from the initial triangulation of the model a hierarchy of progressively coarser triangulations of the model using a sequence of edge contractions to the initial triangulation;

means for connecting the triangulations in the hierarchy using homeomorphisms;

means for homeomorphically mapping edges of a coarsest triangulation in the hierarchy back to the initial triangulation; and:

means for converting the mapped coarsest triangulation to the quadrangulation by matching pairs of adjacent triangles in the coarsest triangulation.

43. (Original) The apparatus of Claim 42, wherein said decomposing means generates a first triangulation from the initial triangulation by contracting a first edge in the initial triangulation, measuring a first error associated with the first edge contraction, determining a first fuzzy rank associated with the first edge contraction and generating a first simplicial homeomorphism based on the first fuzzy rank.

44. (Original) The apparatus of Claim 43, wherein said decomposing means determines an inverse of a composition of the homeomorphisms.

Claim 45 (Canceled).

46. (Currently amended) A computer-implemented method of modeling a three-dimensional surface of an object, comprising the steps of:

- generating from an initial triangulation of the surface, a hierarchy of progressively coarser triangulations of the surface by performing a sequence of edge contractions to the initial triangulation using a greedy algorithm that selects edge contractions by their numerical properties;
- connecting the triangulations in the hierarchy using homeomorphisms; and
- homeomorphically mapping edges of a triangulation in the hierarchy back to the initial triangulation.

Claims 47-51 (Canceled).

52. (New) A computer program product comprising a computer-readable storage medium having computer-readable program code embodied in said medium, said computer-readable program code comprising:

computer-readable program code means configured to generate from an initial triangulation of a three-dimensional surface derived from measurement data collected by digitizing a physical object or sampling a digital representation of an object, a hierarchy of progressively coarser triangulations of the surface by decimating the initial triangulation using a sequence of edge contractions;

computer-readable program code means configured to connect the triangulations in the hierarchy using homeomorphisms;

computer-readable program code means configured to homeomorphically map edges of a relatively coarse triangulation in the hierarchy back to the initial triangulation;

computer-readable program code means configured to convert the relatively coarse triangulation into a quadrangulation by matching pairs of adjacent triangles in the relatively coarse triangulation; and

computer-readable program code means configured to fit a respective grid to each of a plurality of quadrangles in the quadrangulation.

53. (New) The computer program product of Claim 52, wherein said computer-readable program code further comprises computer-readable program code means configured to generate a respective patch over each of the fitted grids associated with each of the plurality of quadrangles in the quadrangulation.

54. (New) The computer program product of Claim 52, wherein said computer-readable program code means configured to convert the relatively coarse triangulation into a quadrangulation comprises means to match the pairs of triangles using a weighting function for edges of the triangles.

55. (New) An apparatus for modeling three-dimensional objects, comprising:
means configured to generate from an initial triangulation of a three-dimensional surface, a hierarchy of progressively coarser triangulations of the surface by decimating the initial triangulation using a sequence of edge contractions;

means for connecting the triangulations in the hierarchy using homeomorphisms;

means for homeomorphically mapping edges of a relatively coarse triangulation in the hierarchy back to the initial triangulation;

means for converting the relatively coarse triangulation into a quadrangulation by matching pairs of adjacent triangles in the relatively coarse triangulation; and

means for fitting a respective grid to each of a plurality of quadrangles in the quadrangulation.

56. (New) The apparatus of Claim 55, further comprising means for generating a respective patch over each of the fitted grids associated with each of the plurality of quadrangles in the quadrangulation.